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PHYSICAL CHEMISTRY.—*The reduction of iron oxides by platinum, with a note on the magnetic susceptibility of iron-bearing platinum.* R. B. SOSMAN and J. C. HOSTETTER, Geophysical Laboratory.

In the course of an investigation on the dissociation pressures and melting temperatures of the oxides of iron, we have repeatedly observed that the platinum crucibles used gained in weight and became stiff, evidently through the absorption of iron from the charges.

Proof of the reduction of magnetite. The following experiment demonstrates the absorption of iron from magnetite by platinum under a very low oxygen pressure. About 1 gram of natural crystalline magnetite from Mineville, N. Y., was heated to 500° in a new platinum crucible (Heraeus "extra rein," dimensions 18 mm high, 8–10 mm diameter) in a platinrhodium tube vacuum furnace,[1] and then cooled. A small amount of gas was given off and was not reabsorbed. This gas produced a pressure of 0.045 mm in a volume of 1300 cc, and was probably nearly all gas "adsorbed" by the magnetite. This gas was pumped out, and the charge then heated to various temperatures between 600° and 1200°. The temperatures were measured by a platinum-platinrhodium thermo-element and potentiometer, and the pressures were read on a 500 cc McLeod gage. A condensed record

[1] This Journal, **5**: 277–285. 1915.

of the first series of heatings is given in Table I. The furnace was then cooled, and the residual gas pumped out. The charge was again heated as recorded in the second part of Table I. The results are shown graphically in figure 1.

TABLE I

FIRST SERIES

TEMPERATURE t	TIME HELD AT t	INITIAL PRESSURE	FINAL PRESSURE	REMARKS
degrees	*minutes*	*mm.*	*mm.*	
		First Series		
22.5		0.00016		
600	18	0.0112	0.0148	Rising at decreasing rate
1000	20	0.0510	0.0562	Rising steadily
1200	23	0.0665	0.0776	Rising steadily
23			0.0744	
		Second Series		
21.0		0.00012		
600	26	0.0111	0.0164	Rising steadily
1000	16	0.0171	0.0216	Rising steadily
1200	18	0.0236	0.0344	Rising steadily
1000	18	0.0350	0.0360	Nearly constant
600	19	0.0350	0.0352	Constant
1200	12	0.0396	0.0447	Rising steadily
600	11	0.0429	0.0426	Constant
21			0.0398	

It is evident from the figures of Table I that a reaction is going on at 1000° and higher which is supplying gas at a fairly steady rate, and that this rate is greater, the higher the temperature. The changes in weight of charge and crucible, given in Table II, indicate that this reaction consists in the liberation of oxygen and the solution of metallic iron in the platinum. When heated in air after cleaning, the crucible showed on the inside the characteristic reddish black color which appears on heating platinum contaminated with iron.

It is also evident that a small amount of gas absorption takes place as the temperature is lowered, since the pressure decreases more than can be accounted for by the cooling of the furnace

tube, but that there is no approach to a complete reabsorption of the oxygen. This decrease of pressure on cooling probably represents the re-oxidation of a small amount of dissociated mag-

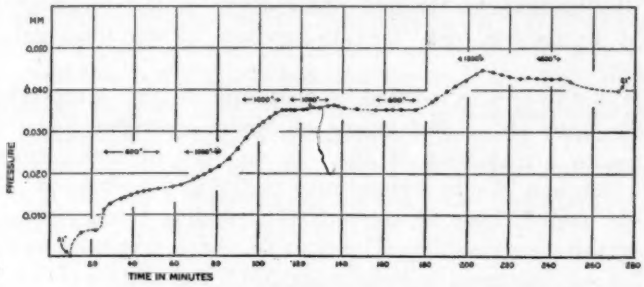

Fig. 1. Evolution of oxygen from magnetite heated in platinum (see Table I).

netite; the dissociation product is as yet unknown. No metallic iron was found in the charge either by solution in hydrochloric acid, which yields bubbles of hydrogen if metallic iron is present, or by the more sensitive copper sulphate test under the microscope.

TABLE II

	INITIAL WEIGHT	FINAL WEIGHT	CHANGE IN WEIGHT
	mg.	*mg.*	*mg.*
Charge and crucible.....	4265.8	4264.7	− 1.1 (loss)
Crucible alone.....	3261.4	3263.2	+ 1.8 (gain)
Charge alone.....	1004.4	1001.5	− 2.9 (loss)

The gain in weight of the crucible, shown in Table II, has been caused partly by the absorption of metallic iron from the oxide, and partly by the absorption of rhodium and also platinum[2]

[2] The analysis of the crucibles shows that the combined weight of rhodium and iron is less than the total gain in weight. No appreciable amounts of other metals seem likely to be present, nor were any found by the analysis. Heating a part of crucible No. 1 in hydrogen for an hour at about 600° produced no measurable loss of weight, showing that no oxide of platinum or iron is present. Some platinum must therefore have been carried from the furnace tube to the crucible, either on account of a temperature gradient between furnace and crucible, or by some disintegrating effect due to the current, or by both causes combined.

from the furnace. The amount of iron absorbed, as calculated from the amount of oxygen evolved and remaining in the apparatus after cooling to room temperature, making no allowance for any permanent thermal dissociation of the magnetite, is found to be 0.9 mg. This is one-half of the total gain in weight.

Magnetite is also reduced by platinum at high temperatures in the open air. 6.608 grams of Merck's reagent Fe_2O_3 was heated to a maximum of 1612° in an open platinum crucible (No. 509) in a 25 mm vertical-tube platinum wire furnace. The charge melted down at about 1582°, yielding black crystalline "magnetite" on cooling. The crucible, which originally weighed 9517.3 mg, increased in weight to 9521.2 mg, a gain of 3.9 mg. Certain points on the bottom of the crucible attracted a light magnetic needle.

Reduction of ferric oxide. Products containing more ferric oxide than magnetite, as well as magnetite itself, seem to be reduced by platinum under a low pressure of oxygen. This action is evident even in products which are practically pure Fe_2O_3. One crucible (No. 2) used in our work on the system Fe_2O_3-Fe_3O_4, after 18 series of measurements, had increased in weight from 2851.8 mg to 2863.0 mg, a gain of 11.2 mg or 0.39 per cent. About one-fourth of this gain is found to be due to iron absorbed. At the close of the measurements this crucible showed the usual iron coloration, produced by cleaning and heating for a few minutes in a flame. Various points on the crucible also attracted a light magnetic needle.

Under 10.2 mm oxygen pressure at 1200°, under which conditions the magnetite is nearly completely oxidized to Fe_2O_3, this crucible gained 1.6 mg. Another similar crucible containing Fe_2O_3 gained 1.0 mg under 18.3 mm oxygen pressure at 1200°. A part, at least, of these gains must be due to absorbed iron. In order to establish definitely the presence of iron in the crucibles, and to determine its amount, we have made both chemical analyses and magnetic tests on the crucibles in question.

Methods of analysis. For the analysis of one portion of crucible No. 2 the platinum metals were separated from the iron by pre-

cipitating the former with hydrogen in sulphuric acid solution.[3] For the other portion of crucible No. 2, and for crucible No. 1, the method of Mylius and Mazzucchelli,[4] by which all metals present could be determined, was employed. In addition to iron, this method showed the presence of rhodium in both crucibles, and this latter metal was also determined. The order of agreement between the two methods for iron is shown in Table III, in which the results of the analyses are given. To test the determination of iron by the method of Mylius and Mazzucchelli, a solution containing 977 mg platinum and 5.00 mg iron was subjected to analysis; 4.83 mg iron was recovered.

TABLE III

METHOD OF ANALYSIS	CRUCIBLE NO.	RHODIUM		IRON	
		Per cent	Amount in crucible	Per cent	Amount in crucible
			mg.		*mg.*
Mylius and Mazzucchelli.....	1	0.077	2.40	0.158	4.90
Mylius and Mazzucchelli.....	2	0.127	3.62	0.098	2.80
Hydrogen precipitation.....	2			0.085	

Magnetic properties of iron-bearing platinum. The apparatus for the magnetic tests was suggested by Dr. C. W. Burrows, of the Bureau of Standards, to whom we are greatly indebted for advice and information in connection with these tests. The procedure consists essentially in weighing the pull exerted on the specimen by a strong electromagnet. In paramagnetic and diamagnetic bodies the force is practically independent of the shape of the specimen.

Since we wished to obtain only comparative figures, we did not attempt to determine the field strength or field gradient. With our apparatus, as set up, 870.2 mg of ferrous ammonium sulphate gave a pull of 1.74 mg, equivalent to 2.00 mg per gram. The pull can be determined to about 0.02 mg by the method of swings.

[3] For the details of this method and for many helpful suggestions, we are indebted to Dr. E. T. Allen of this Laboratory.

[4] Zs. anorg. Chem., **89**: 1–38. 1914.

The mean of two sets taken with reversal of the current eliminates a small correction due to the steel parts of the balance.

One-half of crucible No. 2 had already been dissolved for analysis. The other half was tested magnetically and gave a pull of 0.20 mg. This was so much smaller than the effect which we expected on the basis of preliminary results obtained by Burrows and Burgess at the Bureau of Standards, that we experi-

TABLE IV

TREATMENT	TOTAL WEIGHT	WEIGHT OF IRON IN CRUCIBLE	MAGNETIC PULL	REMARKS
	mg.	*mg.*	*mg.*	
Crucible tested alone.....	3125.2	0	0.0	
Iron deposited electrolytically.....	3153.2	27.4	543.0	Deposit weighs 28.0 mg. but contains some hydrogen, carbon, and moisture.
Heated at 1200° and 0.001 mm. for 8 min.....	3152.6	27.4	35.5	Film of iron still on surface.
Heated at 1200° and 0.0005 mm. for 30 min.....	3152.5	27.4	23.8	Film of iron still on surface.
Boiled in HCl, ignited 1 min. in Bunsen flame, oxide dissolved off in HCl.....	3151.4	26.3	25.2	Film removed.
Ignited in blast lamp, oxide dissolved off in HCl	3149.2	24.1	9.6	
Heated at 1400° and 0.002 mm. for 8 min.....	3149.3	24.1	1.56	
Heated at 1400° and 0.0007 mm. for 11 min.....	3149.7[b]	24.1	1.49	

mented further on the magnetic effects produced by known percentages of iron added to pure platinum. For this purpose a new 10 x 18 mm platinum crucible (Heraus "extra rein") was first tested and found to give no measurable magnetic pull. Iron was deposited in the crucible electrolytically from oxalate solution, and it was then heated in the vacuum furnace, first at 1200°, later at 1400°, in order to dissolve the iron in the platinum. The results are recorded in Table IV.

Nearly twice as much iron was deposited in the same way in a similar crucible, which was similarly treated and tested. In this case the iron was deposited chiefly on the inside of the crucible near the bottom, whereas the iron of Table IV was distributed uniformly over inside and outside. The results of the second test are given in Table V.

TABLE V

TREATMENT	TOTAL WEIGHT	WEIGHT OF IRON IN CRUCIBLE	MAGNETIC PULL	REMARKS
	mg.	*mg.*	*mg.*	
Crucible tested alone	3235.6	0	0.0	
Iron deposited electrolytically	3285.9	44.8	1110.	Deposit weighs 50.3 mg. but contains hydrogen, carbon, and moisture.
Heated at 1400° and 0.001 mm. for 5 min	3280.4	44.8	80.	Unabsorbed iron near bottom.
Heated at 1400° and 0.001 mm. for 5 min	3280.3	44.7	60.	Thin unabsorbed film remains.
Cleaned in HCl, dried	3278.8	43.2	54.	Film removed.
Heated at 1400° and 0.001 mm. for 10 min	3279.2	43.2	2.56	
Heated at 1400° and 0.0005 mm. for 10 min	3279.5[5]	43.2	1.57	Crucible stuck to furnace tube.
Heated at 1400° and 0.0007 mm. for 10 min	3279.6[5]	43.2	1.46	Crucible stuck to furnace tube.

Figure 2 shows that the magnetic effect is very nearly proportional to the weight of the deposit of iron, before heating has driven it into the platinum. (The first point of the curve represents a preliminary plating of crucible No. 3).

The immediate drop in the magnetic effect as soon as the iron diffuses into the platinum is very evident from Tables IV and V,

[5] The crucible stuck to the furnace tube; the gain in weight is probably due to rhodium absorbed.

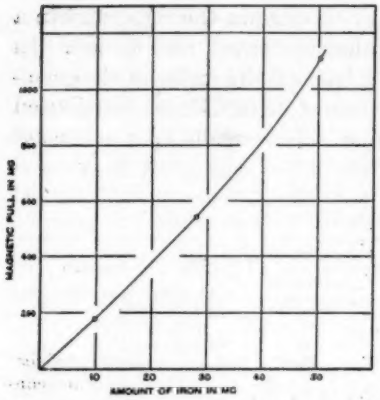

Fig. 2. Relation of magnetic pull to weight of unabsorbed iron.

and from figure 3, which represents graphically the data of Table V. The surprising part of the result is that practically the same ultimate magnetic pull is attained, although one crucible contains nearly twice as much iron as the other. Furthermore, the iron of Table V is concentrated in a smaller area of platinum surface than that of Table IV, which might be expected to make its magnetic effect more than proportional to the amount of iron, instead of which it is found to be independent of the amount. The position of the dissolved iron in the magnetic field is without any important effect, since turning the crucible upside down makes only a few hundredths mg difference in the final magnetic pull.

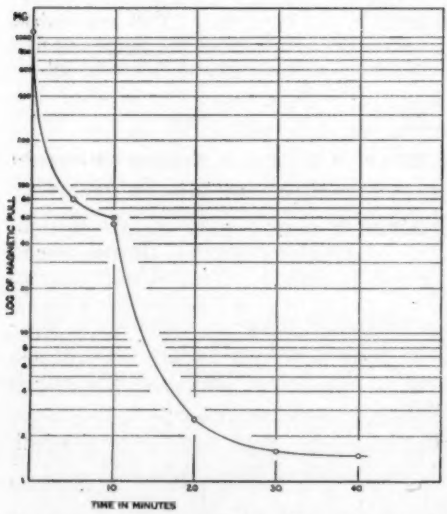

Fig. 3. Relation of magnetic pull to time of heating iron-plated platinum at 1400° (see Table V).

The summarized figures showing the amounts of iron in the various crucibles referred to, and their magnetic effects, are given in Table VI.

It is evident from Table VI that the magnetic pull must depend not only upon the amount of iron present, but also upon other

factors, perhaps its concentration, distribution in the platinum, heat treatment, impurities, or other variables. As we were not prepared to make any extensive study of the questions opened by these results, we have been forced to conclude for the present that the magnetic test alone gives only a qualitative indication of the presence of iron, but no quantitative measure of the amount present.

TABLE VI

	TOTAL WEIGHT	WEIGHT OF IRON	PER CENT IRON	MAGNETIC PULL
	mg.	*mg.*		*mg.*
Ferrous ammonium sulfate	870.2	124.0	14.25	1.74
Crucible No. 509 (page 5)	9521.2	3.9 (or less)	0.04	0.74
Crucible No. 1, used in vacuo	3098.4	4.90	0.158	0.40
" " 2, " " "	2863.0	2.80	0.098	0.39
" " 3 (Table V)	3279.6	43.2	1.32	1.46
" " 4, (Table IV)	3149.7	24.1	0.76	1.49

The work of Isaac and Tammann[6] indicates the cause of the small magnetic effect produced by a considerable percentage of iron when dissolved in platinum. They have found that the magnetic transformation point, which is about 770° in pure iron, is rapidly lowered by the addition of platinum, until at 50 weight per cent platinum it is near 100°. Near pure platinum it would seem to be below room temperature. It is possible, though not proven by their results, that the magnetization of the alloys between 30 and 0 per cent of iron is due to an "α' form" of solid solution crystals, with an inversion curve which falls rapidly with increasing iron content, just as the inversion curve of the α-form of pure iron and of the iron-rich alloys falls rapidly with increasing content of platinum.

Cause of reducing action of platinum. We have shown that platinum acts on both hematite and magnetite at 1200° under low pressures of oxygen, absorbing iron and giving off oxygen.

[6] Isaac and Tammann. Zs. anorg. Chem., **55**: 63–71. 1907.

It also reacts with magnetite in the same way at 1600° and at the usual atmospheric pressure of oxygen. (Hematite is not stable in air at 1600°, but goes over into magnetite). On the other hand, it is well known to analysts that platinum crucibles in which Fe_2O_3 is ignited in air for weighing in analytical procedures take up no such amounts of iron as we have described in previous paragraphs. The reason for these differences of behavior is readily found in the phase rule and the relations of iron and platinum in their alloys.

The system contains 3 components: platinum, iron, and oxygen. Iron and platinum form a continuous series of solid solutions. The oxidation of the iron causes it to separate from the platinum as an oxide. If we now have present the three phases: iron-platinum alloy, solid oxide, and gaseous oxygen, and assume a certain concentration of iron in the platinum (say 0.01 per cent), and a certain temperature (say 1200°) then there must be a definite oxygen pressure in equilibrium with this system. If the existing pressure of oxygen is less than this equilibrium pressure, the oxide will dissociate and metallic iron will be absorbed by the platinum. If the pressure of oxygen be greater, on the other hand, iron from the platinum solution will be oxidized, the oxide will separate on the surface of the metal, and the concentration of the iron in the platinum will be reduced.

It is evident from the fact that melted magnetite is reduced by platinum in air that at 1600° the oxygen pressure of the air (about 152 mm) is less than the oxygen pressure in equilibrium with dilute solutions of iron in platinum. Similarly, at 1200°, 18 mm oxygen is less than the equilibrium oxygen pressure, and at this temperature and pressure iron is absorbed by platinum from all oxides between Fe_2O_3 and Fe_3O_4. The 152 mm oxygen, however, is greater than the oxygen pressure of any but the most extremely dilute solution of iron in platinum at 1200°, and at this temperature, which is seldom exceeded in igniting iron oxide precipitates for analysis, there is no appreciable reduction of Fe_2O_3 by platinum in the open air.

These considerations explain the very common occurrence of small amounts of iron in platinum, since platinum will exercise

its reducing action on any material containing iron oxides with which it comes in contact, provided the temperature is sufficiently high. At low temperatures, on the other hand, and with abundant access of atmospheric oxygen, no appreciable reduction is to be expected.

BOTANY.—*The Australian Fugosias.*[1] F. L. LEWTON, National Museum.

While engaged in a critical study of the species of Gossypium the writer has become convinced that the Australian shrubs assigned by von Mueller and by Todaro to that genus and placed by Bentham under the name Fugosia should be given another designation, as in his opinion neither of the genera named is represented on the Australian continent except by cultivated plants.

A study of the relationships of the twelve species of Fugosia, so called, which have been described from Australia is rendered very difficult by the incomplete description of many of the older species and by the meager representation of plants in American herbaria. The writer has, however, received herbarium specimens of three species directly from Australia and in addition has studied carefully all the material belonging to this group to be found in the United States National Herbarium, the herbarium of the Academy of Natural Sciences of Philadelphia, the combined herbaria of the New York Botanical Garden and Columbia University, the Gray Herbarium of Harvard University, the Field Museum of Natural History and the herbarium of the Missouri Botanical Garden. His conclusions as to the relationships, names and synonymy of these twelve Australian plants are here presented.

As already pointed out by Garcke[2] and by Todaro,[3] the name Fugosia was proposed without any justification by Jussieu[4] in

[1] Published by permission of the Secretary of the Smithsonian Institution.
[2] Bonplandia **8**: 148. 1860.
[3] Relazione sulla cultura dei cotoni in Italia, pp. 86–87. 1878.
[4] Gen. Pl. 274. 1789.

1789 as a substitute for Cienfuegosia, published three years earlier by Cavanilles,[5] who gave the name in honor of Bernard Cienfuegos, a Spanish botanist of the sixteenth century, to a plant collected by Adanson in Senegal. In spite of a partial restoration of the older name by Willdenow[6] and by Sprengel,[7] and its complete restoration by Bartling;[8] Persoon,[9] DeCandolle[10] and Endlicher[11] used Jussieu's abridged form of Cavanilles' name and were followed by later systematic writers, especially Bentham, Hooker, and von Mueller.

The Australian shrubs described by von Mueller and by Bentham as species of Fugosia, when compared with the American and African plants assigned to that genus, appear so distinct in habit and gross anatomy as to warrant their being excluded from the genus, the type species of which is, as above stated, a native of Africa. Furthermore, the Australian species are easily divisible into two groups, already indicated in the Flora Australiensis. Even a very cursory examination of the plants is sufficient to convince one that these two groups have very little in common. In the writer's view they represent two distinct genera, here discussed separately.

THE GENUS NOTOXYLINON

The larger group of Australian Fugosias comprises eight species: *F. australis* Benth., *F. flaviflora* von Muell., *F. latifolia* Benth., *F. populifolia* Benth., *F. robinsonii* von Muell., *F. thespesioides* Benth., *F. punctata* Benth., and *F. pedata* Bailey; which have all, at one time or another, excepting the last, been placed in the genera Hibiscus, Cienfuegosia, or Gossypium. They differ from the African and American species of Fugosia, as the genus is commonly defined, in having the involucre 3-bracted and the black oil glands not restricted to the sepals and capsules but

[5] Monodel. Classis Diss. Decem. 174, *pl. 72, fig. 2.* 1786.
[6] Sp. Pl. **3**: 723. 1800.
[7] Syst. Veg. **3**: 64. 1826.
[8] Ord. Pl. 346. 1830.
[9] Syn. Pl. **2**: 240. 1807.
[10] Prod. Syst. Veg. **1**: 457. 1824.
[11] Gen. Pl. 983. 1840.

found in all parts of the plant except the cotyledons. In all the American and African species assigned to Fugosia the black glands are arranged in rows on the sepals, while these Australian plants agree in having the black glands scattered promiscuously over the surface of the calyx and involucre. From the genus Gossypium they differ, principally, in the total absence of the black oil glands from the cotyledons.

In 1875 Ferdinand von Mueller[12] stated that these species should in his judgment be placed in the genus Gossypium, and three years later Todaro[13] placed them in subdivisions of Gossypium which he named Thespesiastra and Hibiscoidea. The species of the first group were characterized as having small deciduous bracts and a 5-toothed calyx, and those of the Hibiscoidea as having linear, persistent bracts and the calyx 5-parted. The distinctions between deciduous and persistent bracts and between a 5-toothed and a 5-parted calyx can hardly be regarded as of primary importance in this case, since between species which must undoubtedly be classed as true members of Gossypium these same differences actually occur.[14]

It seems to the writer, therefore, that the eight species above mentioned constitute a well-marked group of generic rank for which the name Notoxylinon[15] is appropriate; the new genus to include Todaro's two sections, Thespesiastra and Hibiscoidea. The type of Notoxylinon will be *Gossypium australe* F. von Mueller,[16] which was the first of the included species to be described and is probably the most common in herbaria.

Notoxylinon Lewton, gen. nov.

Shrubs or undershrubs with the habit of Gossypium, glabrous, except on young parts, or tomentose throughout, more or less glandular-dotted. Leaves entire, lobed or pedately parted, with a nectary below near the base of the midvein. Flowers borne on short, extra-axillary branches; peduncle thickened upwards with 3 nectaries at its summit. Involucre of 3 distinct bracteoles, these linear-lanceolate

[12] Fragm. Phyt. Austr. **9**: 127. 1875.
[13] Relazione sulla cultura dei cotoni in Italia, pp. 97–98. 1878.
[14] Compare *Gossypium harknessii*, *G. irenaeum* and *G. hirsutum*.
[15] From νότος, the south wind, and ξύλινον, the cotton plant.
[16] Fragm. Phyt. Austr. **1**: 46. 1858.

or subulate, sometimes reflexed or deciduous. Calyx 5-lobed or 5-parted, conspicuously gland-dotted. Corolla large and showy, yellow or pink, usually with a reddish-purple spot at the base of the petals. Ovary 3- or 4-celled, with 3 or more ovules in each cell. Style undivided, thickened upwards, slightly 3-lobed; stigmas sulcate. Capsule woody, orbicular or ovate. Seeds woolly.

The genus Notoxylinon may be distinguished from Hibiscus by the undivided style and the presence of black glands; from Cienfuegosia by the irregular distribution of the black glands and the 3-bracted involucre; from Gossypium by the absence of the black glands from the cotyledons.

The species of Notoxylinon may be recognized by means of the following key:

Calyx truncate; lobes or teeth small.
- Plant glabrous; bracteoles persistent ..... 1. *N. populifolium.*
- Plant more or less tomentose; bracteoles deciduous.
  - Leaves orbicular-ovate, acute entire; bracteoles subulate ..... 2. *N. thespesioides.*
  - Leaves rhomboid, 3-lobed; bracteoles setaceous ..... 3. *N. flaviflorum.*

Calyx 5-parted or deeply lobed; lobes acuminate.
- Plant glabrous or slightly tomentose.
  - Leaves 3-lobed ..... 4. *N. robinsonii.*
  - Leaves ovate, entire.
    - Petioles less than 1 inch long ..... 5. *N. punctatum.*
    - Petioles 1 inch or more long ..... 6. *N. latifolium.*
- Plant soft hairy or tomentose.
  - Leaves entire or 3-lobed, densely short tomentose ..... 7. *N. australe.*
  - Leaves pedately 5-parted, coarsely stellate hairy ..... 8. *N. pedatum.*

1. **Notoxylincn populifolium** (Benth.) Lewton.
   Fugosia populifolia Benth. Fl. Austr. **1:** 221. 1863.
   Gossypium populifolium F. von Muell. Fragm. Phyt. Austr. **9:** 127. 1875.
   Hibiscus populifolius Kuntze, Rev. Gen. Pl. **1:** 69. 1891.
   Cienfuegosia populifolia Hochr. Ann. Conserv. Jard. Bot. Genève **6:** 57. 1902.
2. **Notoxylinon thespesioides** (Benth.) Lewton.
   Hibiscus thespesioides R. Br. in herb.
   Fugosia thespesioides Benth. Fl. Austr. **1:** 220. 1863.
   Gossypium thespesioides F. von Muell. Fragm. Phyt. Austr. **9:** 127. 1875.
   Cienfuegosia thespesioides Hochr. Ann. Conserv. Jard. Bot. Genève **6:** 58. 1902.

3. **Notoxylinon flaviflorum** (F. von Muell.) Lewton
   Fugosia flaviflora F. von Muell. Fragm. Phyt. Austr. **5**: 44. 1865.
   Gossypium flaviflorum F. von Muell. op. cit. **9**: 127. 1875.
   Hibiscus flaviflorus Kuntze, Rev. Gen. Pl. **1**: 69. 1891.
   Cienfuegosia flaviflora Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 56. 1902.
4. **Notoxylinon robinsonii** (F. von Muell.) Lewton.
   Fugosia robinsonii F. von Muell. Fragm. Phyt. Austr. **9**: 126. 1875.
   Gossypium robinsonii F. von Muell. loc. cit.
   Hibiscus robinsonii Kuntze, Rev. Gen. Pl. **1**: 69. 1891.
   Cienfuegosia robinsonii Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 57. 1902.
5. **Notoxylinon punctatum** (Benth.) Lewton.
   Hibiscus punctatus A. Cunn. in herb.
   Fugosia punctata Benth. Fl. Austr. **1**: 220. 1863.
   Gossypium cunninghamii Todaro, Relaz. Cult. Cotoni Italia, 110. 1877.
   Cienfuegosia benthamii Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 55. 1902.
6. **Notoxylinon latifolium** (Benth.) Lewton.
   Fugosia latifolia Benth. Fl. Austr. **1**: 221. 1863.
   Gossypium costulatum Todaro, Relaz. Cult. Cotoni Italia, 109. 1877.
   Hibiscus latifolius Kuntze, Rev. Gen. Pl. **1**: 69. 1891.
   Cienfuegosia latifolia Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 57. 1902.
7. **Notoxylinon australe** (F. von Muell.) Lewton.
   Gossypium australe F. von Muell. Fragm. Phyt. Austr. **1**: 46. 1858.
   Sturtia hibiscoides F. von Muell. op. cit. **3**: 6. 1862.
   Fugosia australis Benth. Fl. Austr. **1**: 220. 1863.
   Cienfuegosia australis K. Schum. in Engl. & Prantl: Nat. Pflanzenfam. **3**^{6}: 50. 1890.
   Hibiscus australis Kuntze, Rev. Gen. Pl. **1**: 69. 1891.
8. **Notoxylinon pedatum** (Bailey) Lewton.
   Fugosia pedata Bailey, Queensland Agric. Journ. **25**: 286, *pl. 28, fig. 1.* 1910.

THE GENUS ALLOGYNE

The two species of succulent seaside shrubs constituting the smaller group of the Flora Australiensis, *Fugosia hakeaefolia* and *F. cuneiformis*, have been placed at different times in at least three genera, but at no time were they in agreement with the other species of these genera as regards several of their easily observed taxonomic characters. In 1863, Dr. Friedrich Alefeld

proposed the genus Allogyne[17] for *Fugosia hakeaefolia*, and although mistaken in stating that the involucre is wanting, he was correct in separating this species form Hibiscus, where it had been placed when first described by Giordano[18] in 1834. With *F. hakeaefolia* are to be associated three nearly related species, *Hibiscus multifidus* Paxton, *H. lilacinus* Lindley, and *Fugosia cuneiformis* Benth., the four constituting the genus Allogyne.

Allogyne Alefeld.

Succulent, glabrous seaside shrubs, sometimes gland-dotted. Leaves cuneate or spatulate and entire or lobed, or deeply divided into terete or flattened, sometimes deeply toothed segments. Flowers borne on thickened peduncles, showy, not evanescent, persisting several days. Involucre a shallow 5- to 7-toothed cup, situated 3 to 5 mm. below the calyx, the ovary thus appearing stipitate. Calyx deeply 5-parted, its base (within the involucre) covered with nectar-secreting hairs. Sepals lanceolate, not completely valvate, only partially enclosing the bud. Corolla white, blue, or lilac, usually with a crimson-purple eye in the throat. Ovary 4- or 5-celled; style 1; stigma 1, slightly 4- or 5-lobed. Capsule 4- or 5-celled, usually covered with appressed silky hairs. Seeds bristly with spreading hairs, not downy.

The genus Allogyne may be distinguished from Hibiscus by the undivided style, the æstivation of the sepals, and the presence of black glands; from Notoxylinon by its succulent character, epidermal covering, and extra-floral nectary; from Cienfuegosia by the distribution of the black glands and the extra-floral nectary; from Gossypium by the absence of black dots from the cotyledons; and from all the above-named genera by the form of the involucre and the persistent character of the flowers.

The species of Allogyne may be recognized by the following key:

Leaves undivided or occasionally lobed, cuneate or spatulate; flowers white	1. *A. cuneiformis.*
Leaves bipinnate or deeply parted; flowers blue, lilac, or purple.	
Leaf segments flat; corolla without crimson-purple eye	2. *A. lilacina.*
Leaf segments terete; corolla with crimson-purple eye.	

[17] Oesterr. Bot. Zeitschr. **13**: 12. 1863. (Here the name of the genus is spelled Alyogyne and on the opposite page Alyogone, both evidently printed in error for Allogyne, from ἄλλος, different, and γῦνη, stigma.)

[18] Atti del real instituto d'incoraggiamento alle scienze naturali, **5**: 252. 1834.

Involucre conspicuous; corolla lilac-purple ..... 3. *A. hakeaefolia.*
Involucre almost wanting; corolla azure-blue ..... 4. *A. multifida.*

1. **Allogyne cuneiformis** (DC.) Lewton.
Hibiscus capriodorus A. Cunn. MSS. in Herb. Hook.
Hibiscus cuneiformis DC. Prod. **1**: 454. 1824.
Lagunaria cuneiformis G. Don. Syst. **1**: 485. 1831.
Fugosia cuneiformis Benth. Fl. Austr. **1**: 219. 1863.—Curt. Bot. Mag. *pl. 5413.* 1863.
Fugosia cuneifolia F. von Muell. Fragm. Phyt. Austr. **9**: 127. 1875.
Cienfuegosia cuneiformis Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 56. 1902.
2. **Allogyne lilacina** (Lindley) Lewton.
Hibiscus lilacinus Lindley, Edwards' Bot. Reg. *pl. 2009.* 1837.
Lagunaria lilacina Walpers, Bot. Rep. **1**: 311. 1842.
Hibiscus coronopifolius Miquel in Lehm. Pl. Preiss. **1**: 239. 1845.
Fugosia hakeaefolia var. *coronopifolia* Benth. Fl. Austr. **1**: 220. 1863.
Fugosia lilacina G. Don, ex Loud. Encyc. Pl. Suppl. **2**: 1426. 1866.
Cienfuegosia hakeaefolia var. *lilacina* Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 56. 1902.
3. **Allogyne hakeaefolia** (Giordano) Alefeld, Oesterr. Bot. Zeitschr. **13**: 12. 1863.
Hibiscus hakeaefolius Giordano, Att. Real Inst. Sci. Nat. **5**: 252. 1834.
Fugosia hakeaefolia Hooker, Curt. Bot. Mag. *pl. 4261.* 1846.
Alogyne hakeifolia Alefeld, Oesterr. Bot. Zeitschr. **13**: 12. 1863.
Cienfuegosia hakeaefolia var. *genuina* Hochr. Ann. Conserv. Jard. Bot. Genève **6**: 56. 1902.
4. **Allogyne multifida** (Paxton) Lewton.
Hibiscus multifidus Paxton, Mag. Bot. **7**: 103. *pl.* 1840.

ZOOLOGY.—*The correlation of phylogenetic specialization and bathymetrical distribution among the recent crinoids.*[1] AUSTIN H. CLARK, National Museum.

In the recent crinoids there are thirty-seven pairs of obvious contrasted characters which are commonly employed in distinguishing the various genera and families, and which are similarly used in their fossil representatives.

The two contrasted characters in each pair always differ in that one represents a higher grade of phylogenetic specialization

[1] Published by permission of the Secretary of the Smithsonian Institution.

of development than the other; and the one representing the greater degree of specialization always differs from the more primitive in the partial or complete suppression of some structural feature, indicating that phylogenetic progress in the crinoids has been along the line of progressive structural degeneration, resulting in a constantly increasing structural simplification.

If in each contrasted pair we place under each of the two contrasted characters the crinoid families in which it is manifested it is evident that, although in nearly every case the families will be differently divided, an examination of the bathymetrical range of all of the entries under the more specialized characters taken together, contrasted with that of all of the entries under the less specialized characters taken together, will enable us to ascertain with a greater or lesser degree of accuracy the relationship between phylogenetic development and depth.

The number of contrasted pairs in each of the divisions of the crinoid body, and the number of separate items or entries in each of the divisions—that is, the number of citations of families under all the subheadings taken together—are as follows:

	Number of headings	*Number of separate items*
Calyx	10	68
Arms	9	63
Column	7	42
Pinnules	5	35
Disk	5	28
General	1	7
Total	37	243

Being composed of the greatest number of structural units—each a group of similar structural elements—all of which vary more or less independently, the calyx is naturally the most changeable division of the crinoid body.

The arms, through their differentiation into phylogenetically very distinct distal and basal portions, and through the close interdependence of the latter upon conditions in the calyx, form the next most changeable division.

The column, in spite of being fundamentally a simple linear series of similar ossicles, shows very great diversity; and it is chiefly as a result of this diversity in the column and the consequent necessity for a compensating mechanical readjustment that the calyx exhibits such a great amount of variation.

The pinnules and the disk, owing to their intimate connection with the gathering of the minute organisms which serve as food, are able to vary but little from a fixed optimum type.

If we take all of the entries under all of the more primitive characters (1) in all of the thirty-seven contrasting pairs, and similarly all of the entries under all of the more specialized characters (2), and determine their frequency at different depths, we get the following table. Under the heading "General" is included only the number of component ossicles in the skeleton, which decreases greatly more or less in correlation with phylogenetic progress along other lines.

TABLE 1

Frequency at different depths of the more primitive (1) and the more specialized (2) characters, arranged according to the divisons of the body

	Calyx		*Column*		*Disk*		*Arms*		*Pinnules*		*General*	
	1	2	1	2	1	2	1	2	1	2	1	2
0–50	12	14	4	8	7	7	11	15	9	6	1	2
50–100	15	20	8	11	8	9	14	21	14	6	1	3
100–150	15	20	8	11	8	9	15	21	14	6	1	3
150–200	13	15	5	8	5	7	12	15	10	5	1	2
200–250	13	15	5	8	5	7	12	15	10	5	1	2
250–300	15	19	11	9	9	8	20	15	15	5	1	3
300–350	15	19	11	9	9	8	20	15	15	5	1	3
350–400	19	20	11	9	9	8	19	16	15	5	1	3
400–450	19	20	11	9	9	8	19	16	15	5	1	3
450–500	19	20	11	9	9	8	19	16	15	5	1	3
500–550	24	25	15	12	9	10	25	18	19	6	1	4
550–600	28	30	20	14	12	10	29	23	23	7	1	5
600–650	28	30	18	14	12	10	29	23	23	7	1	5
650–700	28	30	18	14	12	10	28	22	23	7	1	5
700–750	28	30	18	14	12	10	28	22	23	7	1	5
750–800	23	25	14	11	11	8	22	20	19	6	1	4
800–850	22	25	14	11	11	8	22	19	19	6	1	4
850–900	22	25	14	11	11	8	22	16	19	6	1	4
900–950	22	25	14	13	11	8	22	16	19	6	1	4
950–1000	18	20	11	9	9	8	18	11	15	5	1	3
1000–1100	18	20	11	9	9	8	18	11	15	5	1	3

TABLE 1—Continued

	Calyx		*Column*		*Disk*		*Arms*		*Pinnules*		*General*	
	1	2	1	2	1	2	1	2	1	2	1	2
1100–1200	18	20	11	9	9	7	18	11	14	5	1	3
1200–1300	18	20	11	9	9	7	18	11	14	4	1	3
1300–1400	18	20	11	9	9	7	18	10	14	4	1	3
1400–1500	13	20	11	9	7	7	17	10	13	4	0	3
1500–1600	13	20	11	9	7	7	17	10	13	4	0	3
1600–1700	13	20	11	9	7	7	17	10	11	4	0	3
1700–1800	13	20	11	9	7	7	17	10	11	4	0	3
1800–1900	11	19	11	9	7	7	16	10	11	4	0	3
1900–2000	11	19	11	9	7	7	16	10	11	4	0	3
2000–2500	11	19	10	9	7	7	16	10	11	4	0	3
2500–3000	9	19	9	9	7	6	16	10	11	4	0	3

The same, expressed as percentages of the whole number in each category:

TABLE 2

	Calyx		*Column*		*Disk*		*Arms*		*Pinnules*		*General*	
	1	2	1	2	1	2	1	2	1	2	1	2
0–50	18	21	9	19	25	25	17	24	26	17	14	29
50–100	22	29	19	26	28	32	22	33	40	17	14	43
100–150	22	29	19	26	28	32	24	33	40	17	14	43
150–200	19	22	12	19	18	25	19	24	28	14	14	29
200–250	19	22	12	19	18	25	19	24	28	14	14	29
250–300	22	28	26	21	32	28	32	24	43	14	14	43
300–350	22	28	26	21	32	28	32	24	43	14	14	43
350–400	28	29	26	21	32	28	30	25	43	14	14	43
400–450	28	29	26	21	32	28	30	25	43	14	14	43
450–500	28	29	26	21	32	28	30	25	43	14	14	43
500–550	35	37	36	28	32	36	39	29	54	17	14	57
550–600	41	44	48	33	43	36	46	36	66	20	14	71
600–650	41	44	43	33	43	36	46	36	66	20	14	71
650–700	41	44	43	33	43	36	44	35	66	20	14	71
700–750	41	44	43	33	43	36	44	35	66	20	14	71
750–800	34	37	33	26	39	28	35	32	54	17	14	57
800–850	32	37	33	26	39	28	35	30	54	17	14	57
850–900	32	37	33	26	39	28	35	25	54	17	14	57
900–950	32	37	33	31	39	28	35	25	54	17	14	57
950–1000	26	29	26	21	32	28	29	17	43	14	14	43
1000–1100	26	29	26	21	32	28	29	17	43	14	14	43
1100–1200	26	29	26	21	32	25	29	17	40	14	14	43
1200–1300	26	29	26	21	32	25	29	17	40	11	14	43
1300–1400	26	29	26	21	32	25	29	16	40	11	14	43
1400–1500	19	29	26	21	25	25	27	16	37	11	0	43
1500–1600	19	29	26	21	25	25	27	16	37	11	0	43
1600–1700	19	29	26	21	25	25	27	16	31	11	0	43
1700–1800	19	29	26	21	25	25	27	16	31	11	0	43

TABLE 2—Continued

	Calyx		*Column*		*Disk*		*Arms*		*Pinnules*		*General*	
	1	2	1	2	1	2	1	2	1	2	1	2
1800–1900	16	28	26	21	25	25	25	16	31	11	0	43
1900–2000	16	28	26	21	25	25	25	16	31	11	0	43
2000–2500	16	28	24	21	25	25	25	16	31	11	0	43
2500–3000	13	28	21	21	25	21	25	16	31	11	0	43

Averaging all of the more primitive characters (in the columns numbered 1) and all of the more specialized characters (in the columns numbered 2) we get the following table.

TABLE 3

	Totals of the columns numbered "1"		*Totals of the columns numbered "2"*	
	with "General"	*without "General"*	*with "General"*	*without "General"*
0–50	18	19	22	21
50–100	24	26	30	28
100–150	25	27	30	28
150–200	18	19	22	21
200–250	18	19	22	21
250–300	28	31	26	23
300–350	28	31	26	23
350–400	29	32	27	23
400–450	29	32	27	23
450–500	29	32	27	23
500–550	35	39	34	29
550–600	43	49	40	34
600–650	42	48	40	34
650–700	42	48	39	34
700–750	42	48	39	34
750–800	35	39	33	28
800–850	35	39	32	28
850–900	35	39	31	27
900–950	35	39	32	28
950–1000	29	31	25	22
1000–1100	29	31	25	22
1100–1200	28	31	25	21
1200–1300	28	31	24	21
1300–1400	28	31	24	20
1400–1500	22	27	24	20
1500–1600	22	27	24	20
1600–1700	22	27	24	19
1700–1800	21	27	24	19
1800–1900	20	25	24	20
1900–2000	20	25	24	20
2000–2500	20	24	24	20
2500–3000	19	23	23	20

The averages given in the preceding table are plotted in figure 1.

In this we see that the more specialized characters outnumber the more primitive down to 250 fathoms, but from that point downward the more primitive characters outnumber the more specialized.

Unfortunately the course of the lines in figure 1 is so irregular as to render difficult a true appreciation of the interrelationships

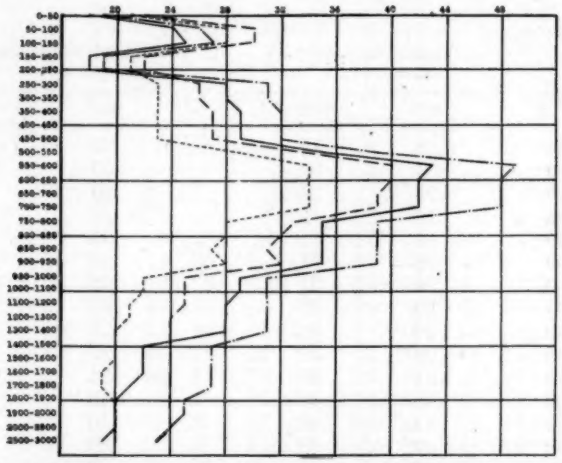

Fig. 1. The bathymetrical distribution of structural characters in the recent crinoids; ———, the more primitive characters, including those under the heading "General;" —.—, the more primitive characters, without those under the heading "General;" — — —, the more specialized characters, including those under the heading "General;" - - - - - -, the more specialized characters, without those under the heading "General."

of the two sets of characters. This difficulty may best be overcome by ascertaining the excess of the primitive or of the specialized characters at the various depths. The figures representing this are given in the following table.

Plotting these (fig. 2), we find that above 250 fathoms the specialized characters predominate; if we include the characters under the heading "General" we find a well marked node at 50–

TABLE 4

Difference between the percentages of the characters "1" and "2" at different depths

	with "General"		*without "General"*	
	excess of "1"	*excess of "2"*	*excess of "1"*	*excess of "2"*
0–50	0	4	0	2
50–100	0	6	0	2
100–150	0	5	0	1
150–200	0	4	0	2
200–250	0	4	0	2
250–300	2	0	8	0
300–350	2	0	8	0
350–400	2	0	9	0
400–450	2	0	9	0
450–500	2	0	9	0
500–550	1	0	10	0
550–600	3	0	15	0
600–650	2	0	14	0
650–700	3	0	14	0
700–750	3	0	14	0
750–800	2	0	11	0
800–850	3	0	11	0
850–900	4	0	12	0
900–950	3	0	11	0
950–100	4	0	9	0
1000–1100	4	0	9	0
1100–1200	3	0	10	0
1200–1300	4	0	10	0
1300–1400	4	0	11	0
1400–1500	0	2	7	0
1500–1600	0	2	7	0
1600–1700	0	2	8	0
1700–1800	0	3	8	0
1800–1900	0	4	5	0
1900–2000	0	4	5	0
2000–2500	0	4	4	0
2500–3000	0	4	3	0

100 fathoms, lying in a zone of higher temperature than the optimum for these animals.

Disregarding the characters under the heading "General," we see that the primitive characters are always in excess below 250 fathoms; this excess reaches a maximum at 550–600 fathoms, slowly rising to only one-third as much at 2500–3000 fathoms.

Including the characters under the heading "General," we

note a maximum development of primitive characters between 850 and 1400 fathoms, beyond which point there is a sharp rise so that from 1500 to 3000 fathoms the specialized characters are in excess.

In regard to the characters under the heading "General" we should remember that, while the number of component ossicles in the skeleton is of considerable phylogenetic significance in shallow water, it decreases rapidly in importance with depth, for the conditions in the abysses are typically such that, chiefly on account of the very limited food supply, no crinoid can grow to the phylogenetically normal size, and hence all the species are necessarily dwarfs, unable to develop to the full the skeleton normal to their type. In other words, in the deeps we find a semi-pathological condition inducing degeneration along the same lines taken by normal phylogenetic advance. It is this semi-pathological degeneration simulating phylogenetic advance which causes the rise in the line representing the figures without those under the heading "General" from 550–600 to 2500–3000 fathoms. This occurs in all the differential characters, but its importance in the skeleton as a whole is here exaggerated for the reason that in this feature we have included only one contrasted pair.

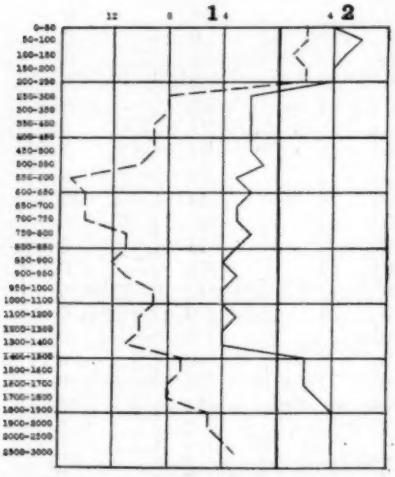

Fig. 2. The excess among the recent crinoids of primitive (1) or specialized (2) characters at different depths, including (———) and without (- - - - - -) those under the heading "General."

Probably in the present study we are most nearly correct if we take above 250 fathoms the line representing the characters

including those under the heading "General," and below 250 fathoms the line representing those without.

If we do this, we find the highest degree of specialization in the recent crinoids above 250 fathoms, and especially between 50 and 150 fathoms, which represents a zone above the optimum temperature for the group.

The least degree of specialization is reached between 550 and 750 fathoms, and this is possibly the maximum depth to which a crinoid can ordinarily descend without undergoing semi-pathological degeneration.

Below 750 fathoms the excess of primitive characters becomes slowly less and less pronounced through semi-pathological changes simulating true phylogenetic advance, so that at 2500–3000 fathoms it is only slightly less than the excess of specialized characters at the surface.

If the preceding deductions are justified,

(1) The most marked phylogenetical advance, which is always evidenced by a greater or lesser suppression of some structural feature, occurs not under optimum conditions for the type under consideration, but under the more or less unfavorable conditions of the warm littoral.

(2) Progressively more and more unfavorable conditions induce a correlated phylogenetical conservatism, and finally a phylogenetical stagnation.

(3) Very unfavorable conditions induce a progressively increasing semi-pathological degeneration which, though usually very different in the details of its manifestation, is biologically the equivalent of phylogenetical advance under the optimum conditions.

(4) Many deep sea types, or types living under similarly unfavorable conditions, which exhibit an extraordinary mixture of very primitive and very highly specialized characters, are to be interpreted as primitive types upon which is superposed a pseudo-specialization induced by the pathological effect of their environment.

ANTHROPOLOGY.—*Fragmentary textiles from Ozark caves.* DAVID I. BUSHNELL, JR., Bureau of Ethnology.

Throughout the Ozarks, from the banks of the Mississippi to the western foothills, and through the northwestern part of Arkansas, caves and smaller rock shelters are to be found in the cliffs bordering the numerous streams as well as in the adjacent valleys. These, with few exceptions, show evidence of long occupancy by Indians. Masses of wood ashes and charcoal, intermingled with fragmentary pottery, some objects of bone and stone, bones of animals, shells, etc., have accumulated near the openings of the caverns, but nothing has been discovered to indicate great antiquity. Many caves within this area have been partially excavated, but unfortunately no complete description of the contents of any one has been published.

It is reasonable to suppose that various pieces of basketry, cloths, and other textiles, all of a perishable nature, have at different times been recovered from masses of ashes in the dry caves, but only two such discoveries can be traced, one in McDonald County, Missouri, the other in Benton County, Arkansas, adjoining it on the south. The specimens are in the United States National Museum and are now described for the first time.

The cave in McDonald County,[1] in which the specimens were found, is described as being "in the valley of Little Sugar Creek," in the southern part of the county not far from the Arkansas line. Little Sugar Creek is about forty miles west of James River, formerly known as the Great North Fork of White, down which valley Schoolcraft passed during the autumn of 1818 and there "saw many of the deserted pole camps of the Osages, none of which appeared, however, to have been recently occupied."[2] This was the hunting ground of the Osage as it had been for many generations, and for this reason the greater part of the material met with in the caves should undoubtedly be considered as being

[1] This was evidently the cave later partially examined by C. Peabody and W. K. Moorehead and briefly described by them in Bulletin I, Dept. of Arch., Phillips Academy, Andover, Mass., 1904.

[2] Schoolcraft, H. R., The Indian in his wigwam. Buffalo, 1848, p. 62.

of Osage origin. However; one piece from the ashes in the cave on Little Sugar Creek probably came from the far Southwest, as there is no evidence of coiled basketry having been known to the Osage or neighboring tribes. This is shown in figure 1. (U. S. N. M. 230,529). It is a fragment of a coiled basket or shield, probably the former. The average diameter of the outer edge is about 20 cm. The diameter of each coil is about 1 cm. The coils are formed of bunches of grass which, on account of the condition, cannot be identified. The other element, which serves

Fig. 1a. One-fourth natural size

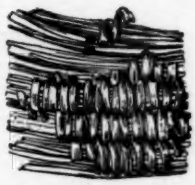

Fig. 1b. One-half natural size

to bind the coils, is black or a very dark brown, very hard, and with a glossy surface; it resembles the fiber obtained from the seed pods of *Martynia louisiana*, known commonly as the unicorn plant or Devil horn. This often attains a length of 35 cm. and was used by the Apache and other tribes in basket work.[3]

The finding of this example of coiled basketry far from its probable place of origin may be accounted for by the fact that the tribes of the southern plains carried on an extensive trade with the Pueblo Indians, while the Osage were their neighbors to the eastward. The trade between the various tribes occupy-

[3] Coville, F. V., Plants used in Basketry; in, Aboriginal American Basketry, by O. T. Mason, in Report of the United States National Museum for 1902, Washington, 1904, p. 207.

ing the vast territory from the Mississippi to the Rio Grande was evidently quite extensive, and long journeys were often undertaken by individuals or large parties. The coming of a trading party from the Pueblos is the event recorded in the winter count of the Kiowa for 1872–1873:

"*Teguăgo Tsăn-de Sai*, 'Winter that the Pueblos came.' In this winter, while most of the Kiowa were encamped on the Washita near Rainy Mountain, a party of Pueblo Indians and Mexicans visited them to trade *biscocho*, or Pueblo bread, and eagle feathers for horses and buffalo robes."[4]

The following four specimens were likewise found in the cave "in the valley of Little Sugar Creek."

Fig. 2. Natural size

Figure 2. (U. S. N. M. 230,534). Border of a mat or basket. The upper line of the drawing represents the finished edge. Each element is about 5 mm. in diameter, but the material is badly decomposed and cannot be identified.

Fig. 3. One-half natural size

Figure 3. (U. S. N. M. 230,536). A loosely twisted cord of Indian hemp, *Apocynum cannabinum*.

Figure 4. (U. S. N. M. 230,538). A fragment of a piece of cloth which at the time of its discovery is said to have been about

[4] Mooney, James, Calendar history of the Kiowa Indians, in Seventeenth Ann. Rept. Bureau of Ethnology, Washington, 1898, p. 336.

45 cm. square, but unfortunately it was cut. The horizontal elements, as shown in the drawing, are about 1 cm. apart; the strands passing in the other direction are rather compact. The former are made of Indian hemp, *Apocynum cannabinum*, dyed red and black, the colors being used alternately. The other strands are hard and brittle and the material was probably derived from the outer surface of a nettle, Urticaceae, used at the present time by the Osage. According to Mr. Francis LaFlesche this is undoubtedly of Osage origin. The blue-black dye used in coloring the strands of Indian hemp resembles the dye even now made by them. It is prepared by boiling together, in water, a quantity of maple bark and red ocher, the latter having first been roasted. To this liquid is added a certain quantity of grease, the result being a blue-black dye or paint.

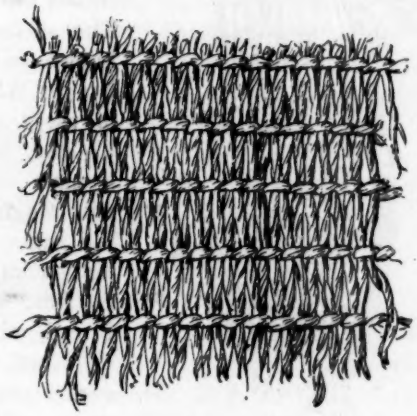

Fig. 4. Natural size

This specimen at once suggests a piece of cloth recovered from a rock shelter on the bank of Cliff Creek, Morgan County, Tennessee, in 1885. The technique of the two is the same, but the latter measures about 115 cm. by 60 cm. and is made entirely of Indian hemp. This, and other objects were "Found in a grave 3½ feet below the surface in earth strongly charged with niter and perhaps other preservative salts. The more pliable cloths, together with skeins of vegetal fiber, a dog's skull, some bone tools, and portions of human bones and hair, were rolled up in a large split-cane mat."[5] These are among the most interesting specimens in the National Museum collection.

[5] Holmes, W. H., Prehistoric textile art of the Eastern United States, in Thirteenth Annual Report, Bureau of Ethnology, p. 30.

Figure 5. (U. S. N. M. 230,533). Fragment of a loosely woven mat or bag. The technique is similar to that of the preceding example. The material has not yet been identified.

Fig. 5. Natural size

Figure 6. (U. S. N. M. 230,714). This was recovered "From a rock shelter on the farm of Mrs. Hardin. The shelter is below a high bluff, known as Eden Bluff, on the north bank of White River and 1 mile south of the town of Monte Né, Benton County, Arkansas. It was found in a mass of dry ashes, intermingled with fragments of limestone. Above the ashes, to a height of 5 or 6 feet, and extending for a distance of 60 or 70 feet, were numerous pictographs in red paint. Other objects found in the shelter were grains of charred corn, corncobs, a strand of coarse grass with a knot, hickory nuts, charred oak, stone implements, bones, shells, etc."[6]

This piece, of unknown use, is about 35 cm. in length. It is made of the inner bark of the basswood, *Tilia americana*. At each end the strands of fiber have been formed into rather tightly wrapped rolls, which, however, do not contain any other substance. The strands extending between the rolls are loose. The fiber is in a remarkably perfect state of preservation.

The Osage at the present time make use of the barks of the basswood, the slippery elm, and the pawpaw.

The discovery of fragments of basketry in a cave within the

[6] Quoted from the notes by E. H. Jacobs, by whom the material was collected. The rock shelter at Eden Bluff is mentioned in the article by Peabody and Moorehead (op. cit.): "The rock-shelter was used in early times for burials, and five or six skeletons have at different times been exhumed; a feature was the 'wild hay,' dried, found in connection with the burials." Unfortunately the 'wild hay' was not identified, and it may, in reality, have been basswood bark.

former Osage area, at once suggests a well-known statement by Hunter[7] when referring to the art of making pottery vessels: "Another method practiced by them is to coat the inner surface of baskets made of rushes or willows with clay to any required thickness, and when dry, to burn them. . . . In this way they construct large, handsome, and tolerably durable ware, though latterly, with such tribes as have much intercourse with the whites, it is not much used, because of the subsitution of cast-iron ware in its stead." This referred primarily to the Osage.

Fig. 6. One-fourth natural size

Very large pottery vessels have been discovered on different sites in the eastern part of Missouri near the Mississippi, important sites being located near Kimmswick, in Jefferson County, and at the mouth of the Saline, in Ste. Genevieve County. Two distinct forms of ware are met with, one bearing the imprint of textiles on the outer surface, the second being smooth on both the outer and inner surfaces. Of these the former is the older.[8]

Among the fragments of pottery recovered from these ancient sites are many bearing the imprint of textiles similar to certain pieces from the McDonald County cave. Although at no time since the discovery of the Mississippi valley have the Osage occupied villages in the eastern part of their territory, which extended to the Mississippi, nevertheless they undoubtedly did so at an earlier day. Consequently the Osage were probably the makers of the large cloth-marked vessels which represent the earlier of the two periods of occupancy, while the smooth ware may be attributed to some Algonquian tribe of a later time.

[7] Hunter, John D., Manners and customs of several Indian tribes located west of the Mississippi, Philadelphia, 1823, p. 297.

[8] Bushnell, D. I., Jr., Archeological Investigations in Ste. Genevieve County, Missouri. Proc. U. S. Nat. Mus. **46**: 662. 1914.

REFERENCES

Under this heading it is proposed to include, by author, title, and citation, references to all scientific papers published in or emanating from Washington. It is requested that authors coöperate with the editors by submitting titles promptly, following the style used below. These references are not intended to replace the more extended abstracts published elsewhere in this JOURNAL.

MAMMALOGY

ALLEN, G. M. *A new bat from Mexico.* Proceedings of the Biological Society of Washington **27**: 109–112. July 10, 1914. (Describes *Rhynchiscus naso priscus*, subsp. nov.—N. H.)

ALLEN, J. A. *The generic names Speothos and Icticyon.* Proceedings of the Biological Society of Washington **27**: 147. July 10, 1914. (Icticyon is shown to be the proper generic name of the South American bush-dogs.—N. H.)

BAILEY, V. *Eleven new species and subspecies of pocket gophers of the genus Thomomys.* Proceedings of the Biological Society of Washington **27**: 115–118. July 10, 1914. (Brief diagnoses in advance of a monograph nearing completion.—N. H.)

CLARK, A. H. *Two interesting mammals from the island of Tobago, West Indies.* Annals and Magazine of Natural History, Ser. 8, **13**: 68–70. January, 1914. (Notes on specimens of Marmosa and Dasypus.—N. H.)

COPELAND, M. *Pipistrellus in Maine.* Proceedings of the Biological Society of Washington **27**: 227. December 29, 1914. (Records of *Pipistrellus subflavus obscurus* from Maine.—N. H.)

GRINNEL, J. *A new race of* Microtus montanus *from the central Sierra Nevada.* Proceedings of the Biological Society of Washington **27**: 207, 208. October 31, 1914. Describes *Microtus montanus yosemite*, from Yosemite Valley.—N. H.)

HANNA, G. D. *Interesting mammals on the Pribilof Islands.* Proceedings of the Biological Society of Washington **27**: 218. October 31, 1914. (Records of polar bears, walrus and sperm whale.—N. H.)

HELLER, E. *New subspecies of mammals from equatorial Africa.* Smithsonian Miscellaneous Collections **63**[7]: 1–12. June 24, 1914. (Describes 15 new subspecies of carnivores and rodents.—N. H.)

HOLLISTER, N. *Descriptions of four new mammals from tropical America.* Proceedings of the Biological Society of Washington **27**: 141–144. July 10, 1914. (Describes one new form each of Ateles, Procyon, Mustela, and Loncheres.—N. H.)

HOLLISTER, N. *A systematic account of the grasshopper mice.* Proceedings of the U. S. National Museum **47**: 427–489, pl. 15, text figs. 1–3. October 29, 1914. (Monograph of the genus Onychomys, with description of one new subspecies from Mexico.—N. H.)

HOLLISTER, N. *New mammals from Costa Rica and Mexico.* Proceedings of the Biological Society of Washington **27**: 209, 210. October 31, 1914. (A new brocket, *Mazama temą cerasina*, and a new two-toed anteater, *Cyclopes mexicanus*, are described.—N. H.)

HOLLISTER, N. *The systematic name of the Brazilian crab-eating raccoon.* Proceedings of the Biological Society of Washington **27**: 215. October 31, 1914. (*Procyon nigripes* Mivart antedates *P. cancrivorus brasiliensis* Von Ihering.—N. H.)

HOLLISTER, N. *The technical names of the common skunk and mink of the eastern states.* Proceedings of the Biological Society of Washington **27**: 215. October 31, 1914. (The skunk known as *Mephitis putida* becomes *M. nigra* and the mink known as *Mustela vison lutreocephala* becomes *M. v. mink*, both dating from Peale and Beauvois, 1796.—N. H.)

HOLLISTER, N. *On the systematic names of the cheetahs.* Proceedings of the Biological Society of Washington **27**: 216. October 31, 1914.

HOLLISTER, N. *The spotted tiger-cat in Texas.* Proceedings of the Biological Society of Washington **27**: 219. October 31, 1914.

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HOWELL, A. H. *Revision of the American harvest mice (genus Reithrodontomys).* North American Fauna No. 36. Pp. 1–97. June 5, 1914. (Complete synopsis of the known forms, seven of which are described as new.—N. H.)

LANTZ, D. E. *Economic value of North American skunks.* U. S. Department of Agriculture Farmers' Bulletin 587. Pp. 1–22. June 4, 1914. (Discusses the value of skunks to agriculture, their value as fur bearers, and the possibilities of raising them for their fur.—N. H.)

LYON, M. W., JR. Tadarida *Rafinesque versus* Nyctinomus *Geoffroy.* Proceedings of the Biological Society of Washington **27**: 217, 218. October 31, 1914. (Tadarida apparently antedates Nyctinomus.—N. H.)

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MILLER, G. S., JR. *Directions for preparing specimens of mammals.* Fourth edition, revised. Part N of Bulletin No. 39, U. S. National Museum. Pp. 1–24. August, 1914.

MILLER, G. S., JR. *Two new North American bats.* Proceedings of the Biological Society of Washington **27**: 211, 212. October 31, 1914. (Describes *Myotis longicrus interior*, from New Mexico, and *M. l. amotus* from Vera Cruz.—N. H.)

MILLER, G. S. JR. *The generic name of the collared peccaries.* Proceedings of the Biological Society of Washington **27**: 215. October 31, 1914. (Dicotyles Cuvier replaces Pecari Reichenbach.—N. H.)

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MILLER, G. S., JR. *Further note on the generic name of the collared peccaries.* Proceedings of the Biological Society of Washington **27**: 229. December 29, 1914. (Pecari is here considered the correct name, instead of Dicotyles.—N. H.)

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STEJNEGER, L. *The systematic name of the Pacific walrus.* Proceedings of the Biological Society of Washington **27**: 145. July 10, 1914. (*Odobenus divergens* replaces *O. obesus*, shown to be a nomen nudum.—N. H.)

ENTOMOLOGY

DYAR, H. G. *Note on Hemihyalea and some species of Amastus.* Insecutor Inscitiae Menstruus, **2**: 146–151. October, 1914. (Gives a key to the species of Hemihyalea, describing one new species; also a key to some of the species of Amastus, describing one new species.—J. C. C.)

DYAR, H. G. *Lepidoptera of the Yale-Dominican expedition of 1913.* Proceedings of the U. S. National Museum, **47**: 423–426. October 24, 1914. (Lists all of the material collected and describes 7 new species and one new sub-species.—J. C. C.)

GATES, B. N. *The temperature of the bee colony.* Bulletin of the U. S. Department of Agriculture, No. 96. Pp. 1–29, figs. 1–8. July 22, 1914. (A professional paper detailing the methods used in the work and results obtained, together with certain phenomena observed in connection with various disturbances of the colony.—J. C. C.)

HEINRICH, C. *A new Californian Coleophora on plum.* Insecutor Inscitiae Menstruus, **2**: 145. October, 1914.

HUNTER, W. D. *The pink bollworm.* Circular of the U. S. Department of Agriculture, Bureau of Entomology. Pp. 1–6, figs. 1–5. August 7, 1914. (An account of an insect injurious to cotton and likely to be introduced into this country.—J. C. C.)

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KNAB, F. *Simuliidae de Chile septentrional.* Anales de Zoologia Aplicada. **1**: 17–22, plate 1. April, 1914. (Describes one new species.—J. C. C.)

KNAB, F. *The oriental trigonometopine flies.* Insecutor Inscitiae Menstruus, **2**: 131–133. September, 1914. (Describes Diplochasma, new genus, and one new species.—J. C. C.)

MARLATT, C. L. *The periodical cicada in 1914.* Circular of the Bureau of Entomology, U. S. Department of Agriculture. Pp. 1–3, figs. 1–3. May 27, 1914.

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PARKER, W. B. *Quassiin as a contact insecticide.* Bulletin of the U. S. Department of Agriculture, No. 165. Pp. 1–8, fig. 1. December 31, 1914. (An account of experiments indicating this preparation has possibilities as a commercial insecticide of moderate cost.—J. C. C.)

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QUAYLE, H. J. *Citrus fruit insects in Mediterranean countries.* Bulletin of the U. S. Department of Agriculture, No. 134. Pp. 1–35, figs. 1–2, plates 1–10. October 7, 1914. (Gives an account of the various insects, including their life history, and of species likely to be mistaken for the injurious ones; discusses natural enemies of the various injurious insects and methods in use for the control of these insects.—J. C. C.)

ROHWER, S. A. *Vespoid and sphecoid Hymenoptera collected in Guatemala by W. P. Cockerell.* Proceedings of the U. S. National Museum, **47**: 513–523. October 24, 1914. (Lists all of the species collected in these groups and describes 11 new species.—J. C. C.)

SCOTT, E. W., and PAINE, J. H. *Lesser bud-moth.* Journal of Agricultural Research, **2**: 161–162. May 25, 1914.

SCOTT, E. W., and PAINE, J. H. *The lesser bud-moth.* Bulletin of the U. S. Department of Agriculture, No. 113. Pp. 1–16, fig. 1, plates 1 and 2. August 22, 1914. (A professional paper giving description, life history, distribution, food plants and recommendations for control.—J. C. C.)

TOWNSEND, C. H. T. *New muscoid flies, mainly Hystriciidae and Pyrrhosiinae from the Andean Montanya.* Insecutor Inscitiae Menstruus, **2**: 123–128 (continued). August, 1914. (Describes the new genera Eusignosoma and Uruhuasia, together with 5 new species.—J. C. C.)

WHITE, G. F. *Destruction of germs of infectious bee diseases by heating.* Bulletin of the U. S. Department of Agriculture, No. 92. Pp. 18. May 15, 1914. (Gives a short account of the four bee diseases now known to be infectious and the minimum temperatures that can be employed for their destruction by means of heat.—J. C. C.)

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 292d meeting was held in the lecture room of the Cosmos Club, on February 24, 1915.

INFORMAL COMMUNICATIONS

M. R. CAMPBELL, *Movement of sand-dunes on the California coast.* The dunes described occur near Monterey. Ordinarily they are not in motion, but are covered with a growth of chaparral, and the impression first produced was that their present stationary condition might denote a change of climate since their formation. Later it was observed that occasional breaches are formed, from which the sand is swept forward in long tongues. After a certain period movement at such a location ceases and the newly formed dunes become covered with chaparral. Thus movement is occurring only here and there at any one time, but after a certain period the material of the whole dune has become shifted.

Discussion: A. C. SPENCER inquired as to the cause of the primary breach. Campbell believed this might be due to a severe storm or an extraordinary wind.

REGULAR PROGRAM

C. J. HARES: *Correlation of some of the Cretaceous and Eocene formations of Central Wyoming.* The uniformity of the Cretaceous formations over much of Wyoming indicates that sedimentation was unobstructed and that the present mountain chains contributed little, if any, of those sediments. The Cretaceous sediments were probably derived in great part from farther west. The mountains rose later, though movement was probably initiated in late Cretaceous.

The best comparison of these formations may be obtained by using the Niobrara as a datum plane. The Niobrara is composed of 200 to 1,700 feet of calcareous shale and limestone, bearing the distinctive *Ostrea congesta* fauna, and marks the maximum extension of deep marine water. The Niobrara is succeeded in Natrona County by 2000 to 3000 feet of dark, marine shale, which is equivalent to the Steele shale of Carbon County. The Steele and underlying formations, except for a narrow outcrop of a White River formation, are continuous from Carbon to Natrona County, but the overlying formations have been eroded. The Steele formation in Carbon County is overlain

by the Mesaverde, which is composed of 1500 to 3000 feet of sandstone, shale, and coal, generally forming two prominent ridges. The lower ridge-forming sandstone of the Mesaverde corresponds to the Parkman sandstone, and its upper ridge-forming sandstone represents the Teapot sandstone of Natrona County. The Parkman and Teapot, with the intervening shaly sandstone, are from 800 to 1500 feet thick. The Mesaverde roughly corresponds to the Judith River of Montana and marks the maximum withdrawal of the Montana sea. Succeeding the Mesaverde in Carbon County is from 600 to 3000 feet of marine shale (Lewis) and marine sandstone in the base of the Lower Laramie. This marine series above the Mesaverde is equivalent to the 1000± feet of marine shale and sandstone in Natrona County between the Teapot sandstone and the Lance. It probably includes within its upper portion beds which are equivalent to the Fox Hills of northeast Wyoming. The Lewis is approximately the time equivalent of the Bearpaw and marks the last great incursion of the Cretaceous sea, which, receding, laid down the Fox Hills sandstone. The upper limit of the marine beds in this area serves as another datum plane. The marine deposits in Carbon County are overlain by 1000 to 6000 feet of continental deposits (Lower Laramie), which are identical in lithologic character, manner of bedding, and topographic expression (moderate ridges) with the 2000 to 3000 feet of Lance beds in Natrona County, which are only 36 miles away. In both there is an entire absence of conglomerate and both have taken part fully in the orogenic movements affecting all the lower formations. The Lance in Natrona and adjacent counties is overlain by 2400 to 4500 feet of Fort Union. The Lance and Fort Union are structurally conformable, as are the Lower Laramie and parts of the Upper Laramie. The peculiar irregularity of structure in the lower Fort Union beds gives them a rough appearance and they form a pronounced ridge in the topography. They are precisely like the basal part of the Upper Laramie in Carbon County. In both Natrona and Carbon Counties these beds contain cherty conglomerate and at Alkali Butte and at Whiskey Peak in Fremont County they contain fragments of Mowry shale, which is a formation in the Colorado group stratigraphically about 10,000 feet below either the Upper Laramie or Fort Union. The first appearance of these fragments of Mowry in any overlying formation is indicative of important orogenic uplifts, and the significance of the evidence cannot be disregarded. This lithologic evidence has been interpreted by Veatch to indicate the existence of an unconformity between the Lower and Upper Laramie, but the remarkable relations of overlap on older beds inhibited by a part of the Upper Laramie may be interpreted as due to an unconformity within the Upper Laramie. At Alkali Butte in Fremont County the Fort Union is only 250 feet above the marine beds, indicating either an unconformity below the Fort Union or an extraordinary thinning of the Lance. The unconformity described by Veatch is not stratigraphically at the place of the assumed unconformity at the top of the Fox Hills.

The fossil evidence is partly in harmony and partly at variance. The Lance contains a *Triceratops* fauna, but the Lower Laramie has been supposed to be entirely barren of dinosaur remains; however, dinosaurs occur in it. Fragments of bones collected near the mouth of Little Medicine Bow and west of Rawlins, about 2000 feet above the top of the Lewis and near the same horizon as some of the *Triceratops* zones in Natrona County, were identified in one case as ceratopsian bones and in the other as dinosaurian. *Triceratops* has been collected from the lower 1000 feet of the Upper Laramie. This is evidence that the Lance is equivalent in age to the lower part of the Upper Laramie, or perhaps that *Triceratops* has a greater stratigraphic range than hitherto assigned, or that faunal zones do not coincide with lithologic boundaries. The invertebrates, *Tulotoma thompsoni* and other fresh or brackish water shells, occur in the Lance and the Lower Laramie. The plants in the Lance as well as in the Upper Laramie are stated to be of Fort Union age, and those in the Lower Laramie of Cretaceous age. The Fort Union flora of the Lance has come chiefly from the upper half of the formation in the Dakotas and Montana, but not from the type Lance in Converse County or the Lance of Natrona County, while that from the Lower Laramie in Carbon County has come in most cases from the very base or from the lower 2000 feet of the formation. This may make some difference in our views regarding the character of the flora, because this series of beds may range up to 6000 feet thick. Most of the leaves that have been collected in Natrona County from the base of the Lance have Cretaceous affinities. Some leaves collected 600 feet above the base of the Lower Laramie have Fort Union affinities. With so much of the Lower Laramie removed by erosion from the syncline east of Walcott, it is easy to see that the Fort Union species which exist elsewhere in the upper part of the Lower Laramie and the Lance may have been missed at that place. The present status of facts does not warrant correlating beds mapped as Lance in Natrona and Converse counties wholly with the Upper Laramie, but, on the contrary, they should for the most part, if not entirely, be correlated with the Lower Laramie.

W. B. Heroy: *The relation of the Upper Cretaceous formations of southern Wyoming and northeastern Colorado.* The upper part of the Upper Cretaceous section in Carbon and Sweetwater counties in southern Wyoming has been described as containing the following formations: Steele shale, 4000 feet; Mesaverde formation, 2000 feet; Lewis shale, 500 feet; Lower Laramie, 1000–6500 feet. The Steele shale is correlated with the upper part of the Mancos shale of Colorado and Utah and with the lower part of the Pierre shale of the Great Plains region. The Mesaverde formation consists generally of two prominent sandstone members separated by a series of softer shaly beds, the lower being approximately equivalent to the Parkman sandstone and the upper to the Teapot sandstone of central Wyoming. The Lewis shale is widely distributed over southern Wyoming and northwestern Colorado. It has been recognized by Hares in his work

in central Wyoming as the shale which lies above the Teapot sandstone and below a marine sandstone which is correlated with the Fox Hills of northeastern Wyoming and of the type locality in South Dakota.

The Fox Hills of central Wyoming is represented in the southern Wyoming section near Rawlins by the lower 800 feet of the "Lower Laramie," a series of sandstones which yields a marine Cretaceous fauna. In Carbon County, as mapped by Veatch, this zone is found in the upper part of the Lewis, the base of the Lower Laramie having been drawn at the top of the marine beds. It thus appears that the Fox Hills sandstone of the type locality is represented in southern Wyoming by a marine sandstone which overlies or forms the upper part of the Lewis. If the Mesaverde of Carbon County, Wyoming, is traced eastward into the Laramie Basin, it is found that the lower member (Parkman) forms the conspicuous "Pine Ridge" near Rock River Station, the upper portion of the Mesaverde (Teapot) having been either entirely removed or obscured by overlying beds. The Lewis shale is not recognized in the Laramie Basin, and together with the overlying marine sandstone member of the Laramie (which is correlated with the Fox Hills), appears now not to extend east of the Medicine Bow. In the Laramie quadrangle, as mapped by Darton in the Laramie-Sherman folio, Steele shale is overlain by Mesaverde sandstone, while the corresponding section east of the Laramie Mountains on Horse Creek, shown on the Sherman quadrangle, consists of Pierre shale overlain by "Fox Hills" sandstone. Darton regards the base of the Mesaverde as mapped on the Laramie quadrangle as the approximate stratigraphic equivalent of the base of the "Fox Hills" of the Sherman quadrangle, and this view is confirmed by Lee, who visited and collected from both localities in 1914. The base of the "Fox Hills" as mapped on the Sherman quadrangle would thus be the same as the base of the Mesaverde (Parkman) This horizon is about 4000 feet lower stratigraphically than the Fox Hills of central Wyoming, which overlies the Lewis shale.

The "Fox Hills" of the Sherman quadrangle as exposed on Horse Creek has heretofore been regarded as the stratigraphic equivalent of the "Fox Hills" of the Denver Basin, which has been traced by Darton northward from the original locality near Platteville to the Wyoming line. The "Fox Hills" of the Denver Basin corresponds with the "Fox Hills" of the Colorado Springs region as described by Richardson and others. If the "Fox Hills" of the Denver Basin is the same as that of the Sherman quadrangle, then it appears probable that the term "Fox Hills" as used in the Denver Basin relates to a much lower stratigraphic horizon than that occupied by the Fox Hills of northeastern Wyoming and in the type locality in northern South Dakota. The "Fox Hills" of the Denver Basin is apparently equivalent to the lower Mesaverde (Parkman) of southern Wyoming, while the Fox Hills of the type locality is equivalent to the basal "Lower Laramie" of southern Wyoming, the top of the Lewis as mapped by Veatch.

G. H. ASHLEY: *The physiography of the Rockies in the Cretaceous-Tertiary period.* The speaker first outlined the physiographic history of the region, pointing out that during Upper Cretaceous time and before the Rocky Mountain region had been the scene of slow, persistent, crustal depression, during which from 1 to 3 or more miles of sediments were laid down. The period closed with movement that stopped sedimentation in the Gulf area and over most of the Rocky Mountain area, though sinking and sedimentation continued in the center of the old basin, resulting in the laying down of the Laramie, Lower Laramie, Black Buttes and possibly Lance rocks. Pronounced uplift followed, resulting in mountain building and the subsequent erosion that cut through the supermontane deposits and base-leveled the elevated Piedmont areas. Then came a period of renewed depression and sedimentation, in which were laid down the Fort Union and possibly Lance formations at the north and many local deposits at the south, including the Raton, Denver, Puerco, Ohio Creek, Upper Laramie, Evanston, and other associated deposits, which were derived from the recently uplifted lands and overlie unconformities in the Piedmont regions but not away from the mountains. Renewed uplift and erosion preceded the deposition of the Wasatch of early Eocene age.

The position of the Lance in this physiographic outline was discussed in some detail from both the stratigraphic and paleontologic sides, the conclusion being reached that while many facts suggest correlation with the Laramie, and that while the formation was laid down before the first mountain-uplift, the evidence as a whole strongly points to the post-Laramie age of the beds.

Comparison was then made between the physiographic history of this period in the Rocky Mountain province and that in the Gulf province, the comparison seeming to show that the sea withdrawal in the Gulf region corresponded to the sea withdrawal and the first period of mountain building in the Rockies, and that the return of the sea in the Gulf region and the laying down of the Eocene Midway and Willcox formations in that region corresponded in time with the deposition in the Rocky Mountain region, of the Fort Union, and possibly Lance formations at the north and with the local sediments referred to at the south, and that on that basis those formations must have been of Tertiary age.

Discussion of the papers of Hares, Heroy, and Ashley: W. T. LEE spoke in confirmation of the correlation of the Mesaverde of the Laramie Basin with the socalled Fox Hills of the Sherman quadrangle east of the Laramie Mountains. His opinion was based on stratigraphic succession and on marine fossils collected in both regions. T. W. STANTON said that as regards the correlation of the Mesaverde of Laramie Basin with the Fox Hills sandstone of Horse Creek, Wyoming, as advocated by LEE and HEROY, the views expressed might possibly be correct. The section at Horse Creek is obscured by overlap of the White River group. The highest fossils from Cretaceous beds in the neighborhood are certainly older than Fox Hills. But even if the sand-

stone mapped as Fox Hills at Horse Creek should prove to be Mesaverde, this would not have any necessary bearing on the correlation of the Fox Hills sandstone of northern Colorado. The area from Fort Collins and Greeley south to Boulder has recently been examined with care, and full collections of fossils have been obtained from the Fox Hills. The Fox Hills fauna of this area corresponds closely with the typical Fox Hills fauna of northern South Dakota, and the identification of the same formation in the two areas is as complete as can be expected over such a great distance. While it is true that the Fox Hills fauna may be considered the littoral facies of the Pierre fauna, and that in a broad sense it began long before Fox Hills time in the Eagle and was repeated in the Claggett, yet each of these recurrences has its distinctive species, so that when the fauna of the whole formation is considered it is not difficult to distinguish Fox Hills from Claggett and Eagle, though they have a good many species in common.

The true Fox Hills fauna of the type area is distinguished from all the earlier faunas of the region by the presence of the ammonite *Sphenodiscus* instead of *Placentoceras*, by a group of *Scaphites* including *S. conradi*, *S. nicolleti*, *S. cheyennensis*, *S. mandanensis*, by a number of gastropod genera and species, and by the absence of *Baculites*, *Inoceramus*, etc. In all these respects the Fox Hills fauna of northern Colorado is identical. HEROY's proposed correlation of the Fox Hills of northern Colorado with the Mesaverde of northern Wyoming cannot be accepted because the detailed paleontologic evidence is opposed to it, and because there are several important lower sandstones within the Pierre shale of northern Colorado which probably represent Mesaverde sedimentation. Time was lacking for an adequate discussion of the papers by HARES and ASHLEY. Concerning the latter, STANTON remarked that many of the opinions expressed could be characterized as "interesting if true."

C. N. FENNER, *Secretary*.

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 537th meeting of the Society was held at the Cosmos Club, Saturday, March 6, 1915, at 8 p.m., with Ex-President STEJNEGER in the chair and 60 persons present.

Under the heading Brief Notes A. S. HITCHCOCK called attention to the plans and methods of work in preparing a new Flora of the District of Columbia, which it is hoped, will be completed within a year. It will contain analytical keys to the genera and species of ferns and flowering plants found within a radius of 15 miles of the city of Washington, but will not include descriptions.

The first paper of the regular program was by J. W. GIDLEY: *Notes on the possible origin of the bears*. After the examination of much fossil and living material the speaker had arrived at the conclusion that the bears, constituting a small homogeneous, widely distributed group,

are not closely related to the Carnivores. From a consideration of the tooth structure, the bones of the feet, and the basal cranial foramina, Mr. GIDLEY concluded that the bears were probably derived from the *Claenodon* group of the Creodonts, and that the Carnivores were descended from the Miacidae, a family of Creodonts not distantly related to the *Claenodon* group.

The second communication was by the sculptor, H. K. BUSH-BROWN: *The evolution of the horse.* The speaker was present by special invitation of the President and was introduced to the Society by Ex-President STEJNEGER. He discussed briefly the geological evolution of the horse, and then spoke at some length on the evolution of modern breeds of horses, particularly the Arab, the effects of breeding it with other races, and its development in this country. His paper was well illustrated by lantern slides showing anatomical characteristics of various horses, as well as external appearances.

On Thursday, March 11, 1915, at 8.30 p.m., the Biological Society held a joint meeting with the Washington Academy of Sciences in the Auditorium of the National Museum. Mr. WILFRED H. OSGOOD, of the Field Museum of Natural History, and a member of the special commission for investigating the fur seal question for the Department of Commerce during the summer of 1914, delivered a lecture illustrated by stereopticon and motion pictures of the fur seals and other animals of the Pribilof Islands. All phases of the life of the seals on the islands, methods of killing, skinning, salting, etc., and the introduced herds of reindeer, the Steller's sea-lions, and the native birds were shown in motion pictures. About 350 persons were present.

The 538th meeting of the Society was held at the Cosmos Club, Saturday, March 20, 1915, with President BARTSCH in the chair and 45 persons present.

Under the heading Brief Notes, General WILCOX called attention to a Cedar of Lebanon near Jackson's statue in Lafayette Square.

The first paper of the regular program was by T. S. PALMER, *Notes on the importation of foreign birds.* The speaker discussed the subject with special reference to canaries, parrots, and game birds. He stated that about 500 permits for importation of birds are issued annually by the Department of Agriculture, the number of birds imported in a year amounting to about half a million, as many as 17,000 birds arriving in a single day. The number of species imported is about 1500, though canaries constitute by far the largest number brought in. Methods of breeding birds abroad, caring for them in transit, and selecting and teaching singers and talkers were explained. Dangers of importing contagious diseases, as the "quail disease," and methods of quarantining were pointed out. The effect of the European war on the importation of birds was commented upon. The paper was discussed by Messrs. BARTSCH, STILES and GOLDMAN.

The second paper was by NED DEARBORN, *Notes on the breeding of minks in captivity.* Among the habits of the mink attention was called to their profound diurnal sleep, cries emitted, polygamous nature, and cat-like character of food. The speaker stated that the period of gestation was found to be 42 days; number of young at birth 1 to 8; eyes of young remain closed for one month after birth; young may be weaned at 6 weeks; minks breed when a year old; their fur is suitable for market at a year and a half; experiments showed that different types of diet had no effect on quality of fur. The speaker concluded that breeding of minks for commercial purposes was possible. The paper was discussed by Messrs. WETMORE, A. B. BAKER, and COOKE.

The third paper was by M. W. LYON, JR., *Endamoeba gingivalis and pyorrhea.* The speaker discussed the cause of pyorrhea or Rigg's disease, the *Endamoeba gingivalis*, recently discovered by Dr. ALLEN J. SMITH and others. He called attention to the pathologic lesions produced by the Endamoeba and by the various bacteria associated with it; mentioned the amoebicidal action of emetin hydrochlorid administered systemically or locally; and reviewed some of the early references to the Endamoeba before it was considered the cause of pyorrhea. The paper was illustrated by lantern slides of Gros' original drawing of the organism, and of several photomicrographs and drawings of living and stained Endamoebas, bacilli, and spirochaetes from a case of pyorrhea. The paper was discussed by Messrs. STILES and GOLDMAN.

M. W. LYON, JR., *Recording Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 479th meeting of the Society was held Tuesday evening, December 15, 1914, in the lecture hall of the Public Library. The speaker of the occasion was the distinguished German scholar, Geheimrat Dr. FELIX VON LUSCHAN, director of the Museum für Völkerkunde in Berlin and for a number of years in charge of the archeologic excavations carried on under the auspices of the German government in Asia Minor. Doctor VON LUSCHAN had been a delegate in attendance at the Australian meeting of the British Association in September, but owing to the outbreak of the war has been compelled to make a somewhat extended stay in this country before endeavoring to return home. He is utilizing this time in a study of race mixture in the American negro, having already visited for this purpose a number of points in the southern states, including Tuskegee, and traced out for future analysis several hundred pedigrees of mixed Afro-American origin. He is accompanied by Mrs. VON LUSCHAN, who is herself a competent authority and an efficient helper in his anthropological investigations.

In his lecture before the Society Doctor VON LUSCHAN chose for his subject, *The excavation of a Hittite capital*, dwelling chiefly upon his work at Boghaz-Keui, the site of the capital of the ancient empire of the Hittites, who, fifteen centuries before the birth of Christ, occupied the central portion of Asia Minor and for hundreds of years held the

balance of power between Egypt and Babylonia, until finally overthrown by Sargon, King of Assyria, in 717 B. C. They were variously known as Hethites, Hittites, Hatti, Khiti, etc., and, from their sculptures, appear to have been a broad-headed people of rather short stature and irregular features, of the physical type represented by the modern Armenians, although their linguistic affinity is not yet established. Their inscriptions are recorded both in hieroglyphic and in cuneiform characters. Their sculptural art is crude but strong, the winged lion, winged sun, and double eagle motifs being of frequent occurrence. Facsimiles in plaster of a number of the more important sculptures taken out under Doctor VON LUSCHAN'S supervision are now in our own National Museum by courtesy of Berlin. The lecture was illustrated with a fine series of lantern slides.

At the 480th meeting of the Society, held January 5, 1915, in the Public Library, Dr. JOHN R. SWANTON, of the Bureau of American Ethnology, read a paper on the *Ethnologic factors in international competition*. About 25 persons were present. Dr. Swanton reviewed the different factors tending to bring about union and disunion between human societies. He showed that these had been operative in all parts of the world and stood for two great complementary principles which were probably necessary to the best development of the race as a whole. At the same time it is not necessary or desirable for the principle of disunion to extend to open war. The end of warfare may be confidently predicted from the constant increase in size and decrease in number of political units, from the progressive weaving of the world more closely together by means of transportation facilties and other means of communication, not to mention the gradual international bankruptcy which war entails. Next, the evolution of a standing army was traced and its copartnership noted with an aristocratic ruling class. The integration of smaller states into larger was shown to be brought about in two ways; by the alliance of coordinate units, and by combinations in which some were subordinate and some dominant. States of the latter class have resulted largely from war; and it was shown that two kinds of subordination took place, subordination of peoples as a whole without the entire break up of their internal organization and subordination of classes. It was stated that this latter kind of subordination was largely responsible for slavery and serfdom successively; and it was alleged that it has left its stain upon modern society, in which subjection has been transferred to the economic field and has been accomplished by an extension of the laws of property enabling one class to levy a heavy toll for the use of things which another class needs. There can be no permanent peace until exploitation of one nation or class by another comes to an end and the principle of "home rule" is extended with due relativity down to the smallest political and industrial groups.

Several members discussed the paper.

DANIEL FOLKMAR, *Secretary.*

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